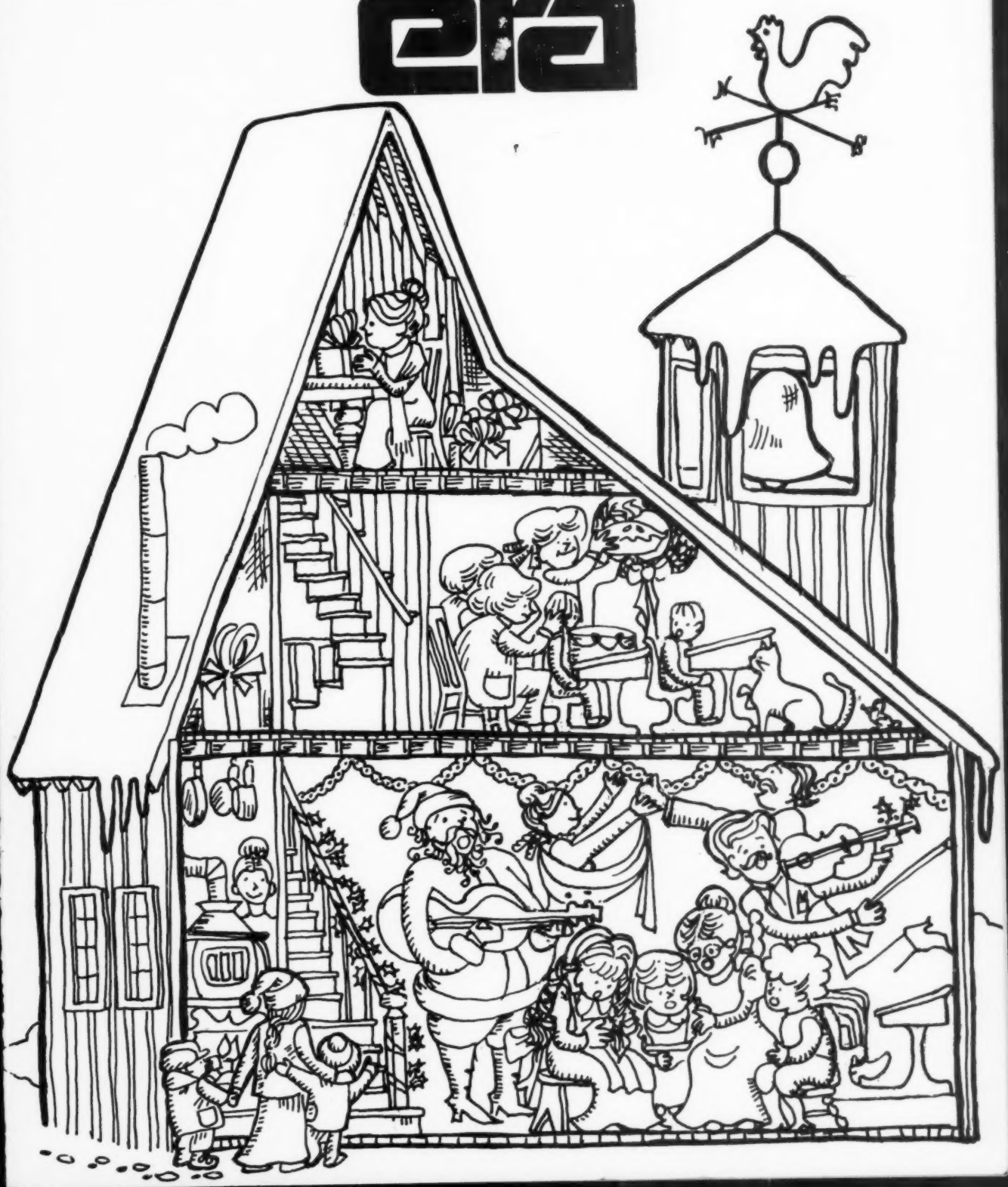
A Water Review Quarterly

RECLAMATION

era

Winter 1975



RECLAMATION

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Winter 1975

Vol. 61 No. 4

United States Department of the Interior
Thomas S. Kleppe, Secretary

Bureau of Reclamation
Gilbert G. Stamm, Commissioner

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Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director, Office of Management and Budget, February 3, 1975.

For sale by the Superintendent of Documents , U.S. Government Printing Office, Washington, D.C. 20402. Price: $1.05, single copy; $4.00, subscription, per year ($1.00 additional for foreign mailing).

Columbia Basin Remembered by a Homesteader

by Katie Clayton

Picture a vast expanse covered with sandy soil and sagebrush—a 20-mile radius of almost desert conditions.

To such a scene came William Robert and Mary Jane Bailie when they left their Missouri farm in 1903 and headed West. Their motivation for moving is difficult to ascertain—perhaps they were responding to extensive advertisements by the railroads which lured many people West, or perhaps moving West appealed to their pioneering spirit. But for whatever reason, the Bailies went West and settled in the Columbia Basin in south-central Washington.

Katie Clayton, a journalism graduate, was a 1975 summer Hinckley Institute of Politics Intern for the Bureau of Reclamation, Washington, D.C. She currently is a second-year Master's of Business Administration student at the University of Utah.

The Bailies acquired their land in the Columbia Basin by homesteading. The Homestead Act of 1862, which encouraged settlement of western lands, allowed people who lived and worked on land for a period of 5 years to obtain title to that land. The act succeeded in bringing people West. Some, like the Bailies, settled in the Columbia Basin, unsuspecting of the difficult, almost impossible life they would face there.

Loen is the youngest of the 11 Bailie children, and at 75, he still resides in the Basin. He recalls, "The country was dry, very dry. The first thing we had to do in order to farm was break out the sagebrush with horses and mules."

To do this, most early Basin farmers used a 40-foot railroad steel rail which was pulled over the ground by horses, four at each end. According to Loen, the farmers obtained the rails by going down to the railroad track, which ran across the Basin, and helped themselves to a few when nobody was looking. Loen said that railroad officials were pretty lenient about this. They usually looked the other way when it happened because they realized the farmer's need for rails.

Then the farmer used a mouldboard plow to turn over the soil. "That is what ruined the country out here," says Loen. Farmers plowed up the land, leaving the soil completely barren—prey to tremendous wind storms that plagued the area. Much top soil was lost to the wind.

Farmers later learned that if they left the stubble on top of the ground rather than turned it under with a plow, the precious

The barren Columbia Basin before irrigation brought life to the land.

top soil was prevented from blowing away. But this discovery came too late for the many who had already abandoned their unsuccessful homesteads.

Perhaps moving West appealed to their pioneering spirit.

Weeds, too, were a problem. The early Columbia Basin settler had no machinery for weeding. "We tried to harrow it off, but that didn't work," says Loen. "Some of the farmers in the area finally invented a sort of a weeder—an iron rod which was dragged just beneath the ground's surface to uproot the weeds."

A lonely old shack stands as a reminder of days gone by.

The weeder was a dangerous thing to use because the farmer had to ride the tail board and when the rod hit an obstacle, such as a rock, the farmer could be thrown from the tail board. Loen's brother broke his jaw by "riding the rod."

The Bailies tried to grow wheat on their farm. They relied on rain for moisture and their harvest was sparse. "You could count the heads of grain in the field," recalls Loen. The grain that was harvested was fed to the hogs, chickens, and cattle, and what was left over, if any, was sold. The Bailies' grocery money often came from the cream they sold which they got from their cow.

The life of a Columbia Basin homesteader was hardly a luxurious one. Loen describes the Bailie home—a typical homestead shack. "The original house was a meager one-room, unpainted shack, about 12 feet by 16 feet. Eventually we added two wings, a kitchen and a bedroom, and then a lean-to, used as a bedroom. We didn't have much furniture—a bed, table, heating stove, and a small reading desk in the main room with maybe a knit rug or two thrown over the shiplap floor. Ticking away the hours was an old grandfather clock we brought all the way from Missouri," recalls Loen.

Loen said that in addition to the house, the Bailie place had a barn, henhouse, shop, granary, and a poplar tree in the front yard—which made the Bailie front yard a popular place to play.

The Bailies tried to grow wheat on their farm. They relied on rain for moisture and their harvest was sparse.

Early Basin residents lived without luxuries which many Basin residents would take for granted. Today, homes in the Basin are modern and comfortable, with conveniences that early settlers would never have dreamed of.

Loen Bailie, however, remembers the days when water for the Bailies' culinary use had to be hauled in from the river about 10 miles away. "We hauled water in a big wooden barrel with a wagon and a team of horses,"

recalls Loen. "In 1910 my father drilled a well near the house, but it wasn't until the 40's that it was piped to the house."

Electricity was also late in coming to the Basin. However, the Bailies were luckier than most Basin residents because they got electricity in 1954.

They got electricity in 1954.

They were able to hook onto the powerline to a nearby radar station, being built by the Federal Government.

But the telephone system in the Basin is another story. There have been telephones in the Basin since 1910. Local farmers were responsible for stringing a telephone line along one of the fence lines. This line served 32 residences and each residence had its own ring.

"When a call would come in," says Loen, "everyone would listen for his ring. After the party had answered and started talking everyone else could stop listening."

According to Estella Bailie, Loen's wife who has also resided in the Basin since the early days, "the community was more closely knit than now.

"We never thought we'd see the day when we didn't know all of our neighbors," says Estella, "but that day has come."

Dancing was the main entertainment. People came from miles around to a dance at the old school house. Local talent provided the music—usually a guitar and fiddle. Everyone provided the food. Sandwiches, pies, cakes—all sorts of goodies were on the menu. And coffee—there was lots of coffee—usually made in a copper wash boiler which was primarily used for boiling clothes.

The Bailie homestead.

"We'd dance until midnight and then take a break and eat . . . then dance some more—until about sunup, eat some more and then head home just in time to do the morning chores," says Loen.

There was lots of coffee, usually made in a copper wash boiler which was primarily used for boiling clothes.

The school was also the setting for annual Christmas parties.

"We'd all gather at the school to sing and eat," recalls Loen. "Local folk would put on skits, recitations, and songs. There would be a Santa Claus for the kids, and they would each get a sack of candy and goodies," says Loen.

Loen remembers the first Christmas party at the school. "The community folk were unable to come up with a Christmas tree so they made an arch and covered it with fancy paper."

The old school house, too, could be considered a luxury by early Basin residents. Before the school was built, Loen and his comrades went to school in abandoned homestead shacks. The first school session lasted

Loen and Stella Bailie.

only one month in the summer, but from then on school went full term.

During the first few years there were about 40 students, but the number dropped to three in just 2 years as families realized they could not raise enough food for subsistence, and gave up their homesteads in search of better places to live.

The first school session lasted only one month in the summer.

The school, partially built by Loen's father, was a one-room wooden structure with windows, desks, and a big heating stove.

"For the first few years, the school was lit with kerosene lamps," says Loen. "Then we used gasoline lamps for a while, but sometimes these had to be turned off because they'd start smoking and we couldn't see," he said.

"Water was hauled to the school from the river and stored in a big barrel," says Loen. "We all drank from a common dipper out of a bucket near the entrance of the room . . . later a cistern was constructed and water was piped to the school. But the water still had to be hauled from the river to the cistern.

Grades one through eight were taught at the school. Those who wanted to go to high school had to move away. Loen went to high school in Spokane where he lived with his sister.

In addition to school, youngsters in the Columbia Basin were kept pretty busy with farm chores.

"I'd get up generally about 5:00 a.m. and do an hour's worth of chores, have breakfast, do another hour's worth of work—feed the pigs and chickens and milk the cows—and then head off for school," says Loen. "After school it was the same thing," he continues, "but when all was done and supper was over we'd gather in the main room around the kerosene lamp and read or talk. Mother would sew."

There wasn't much of a formal religious life in the early Columbia Basin. According to Loen, "Religion was more a family than community affair. That was because there was no regular preacher in the Basin and the distance to a regular church was too far to travel.

"When a stray preacher happened by we'd have church at the school. Otherwise our family's religious life consisted of gathering together, reading the Bible and having family prayer," recalls Loen.

Life in the Basin was tough. Many families left in desperation, having no success in raising a crop in the dry, sandy Basin. Loen's parents eventually left, too, after they failed to make even enough money to pay taxes on their property.

In 1929, Loen bought his parents' place for $160—5 years worth of back taxes.

"Irrigation has turned the Columbia Basin into one of the bread baskets of the world."

Life wasn't all that easy for Loen either. His first crop was harvested in 1929 from 160 acres and he got about five bushels of wheat per acre. The wheat sold for 34 cents a bushel, so his gross income for that year was $272. But things got even worse in the depression.

"That was tough," recalls Loen. "I couldn't make anything by farming so I worked for wages—on other farms, and selling farm machinery and insurance. But my steady income of $7 a week came from the cream I sold to the creamery in Seattle."

Loen's first good crop, sold for 90 cents a bushel, came in 1939. That year he also bought a carload of heifer calves from Montana at $5 a head. Ever since then Loen's farm has been an operation mostly of wheat and cattle.

Back in the 1930's much of the land around Loen's farm

was selling for back taxes so he bought as much as he could. "I paid anywhere from $1 to $7 an acre," says Loen, "and eventually accumulated 15,000 acres."

Irrigation has freed the Basin farmer from his dependence on the sometimes-scarce rainfall.

Loen's experience shows that it was possible for some rugged individuals to eke out a living as farmers in the Columbia Basin before the coming of the Columbia Basin project and irrigation. However, irrigation has freed the Basin farmer from his dependence on the sometimes-scarce rainfall.

The Columbia Basin project provides water and electric power for farms in the Basin, such as the Bailies' farm. With the Columbia Basin project have come many changes in the Basin. What was once a desert is now covered with crops.

"A person living here now can't imagine what it was like before," says Loen, ". . . It's a different country entirely now."

In the early days there was much space between homesteaders. Bailies' place was the only place for miles around and according to Loen, "When it got dark—it was dark—there wasn't a light in sight."

But today one who scans the countryside at night from the Bailies' farm sees lights—almost like a city.

The improved possibility of successful farming in the Basin has lured many a farmer and his family to the Basin. "It used to be that we could travel down the road from our place and not see a single house," recalls Estella Bailie, "but now we can see a house every half mile or so."

Othello, a Basin town not far from the Bailies' home, has also grown and is now the site of food-processing plants and other food-related industries, and business and entertainment facilities necessary to appease the growing Basin population.

"Years ago it was quiet out here," says Loen. "I could go out to work and hear only a bird or coyote . . . but now, all I can hear are tractors and trucks rushing by with their radios blaring."

Loen traded much of his land with the Bureau of Reclamation for grazing land outside the

Today's modern homestead.

Today the Columbia Basin is a checkerboard of cropland, thanks to irrigation.

project. He developed 3,300 acres into the largest private land development in the Basin. Loen developed ready-made farms which he sold (on no down-payment terms) to farmers who were anxious to get a start in the Basin.

Each farm included a modern home, complete with water, electricity, and kitchen conveniences which the early Basin settlers would never have imagined. A machine shed, an irrigation system (sprinkler or otherwise), and fields—leveled and ready to plant—were included in the deal. The farmer even had the option to move in with cover crops already planted.

Five hundred acres of Bailie land, which includes the original Bailie homestead, has been turned into the Bailie Memorial Boys Ranch, a ranch for orphaned and delinquent boys.

The ranch, established in memory of Bailie's parents, was incorporated in 1958 and has since been turned over to the Northwest Convention of the Southern Baptist Church. It has three cottages, each housing 12 boys, an activity center and a building for the superintendents.

Boys on the ranch help with ranch chores, and in their spare time have access to rangeland where there are lakes and streams for fishing and swimming.

Today Loen still farms, although he says farming for him now is more of an avocation than a living. He and Estella live in a comfortable, modern brick home—quite a contrast to the early homestead shacks. The Bailie farm this year is producing some of those famous Washington Delicious apples, which are bigger and juicier than ever, according to Mrs. Bailie.

"Irrigation has turned the Columbia Basin into one of the bread baskets of the world," says Loen.

The Basin produces great quantities of wheat, potatoes, peas, carrots, sugar beets, and apples.

Irrigation, at least in part, is responsible for the prosperity of the Columbia Basin, and the Columbia Basin project is responsible for the irrigation waters that quench the thirst of the once dry lands.

Where sagebrush once reigned, crops now grow.

Where sagebrush once reigned, crops now grow.

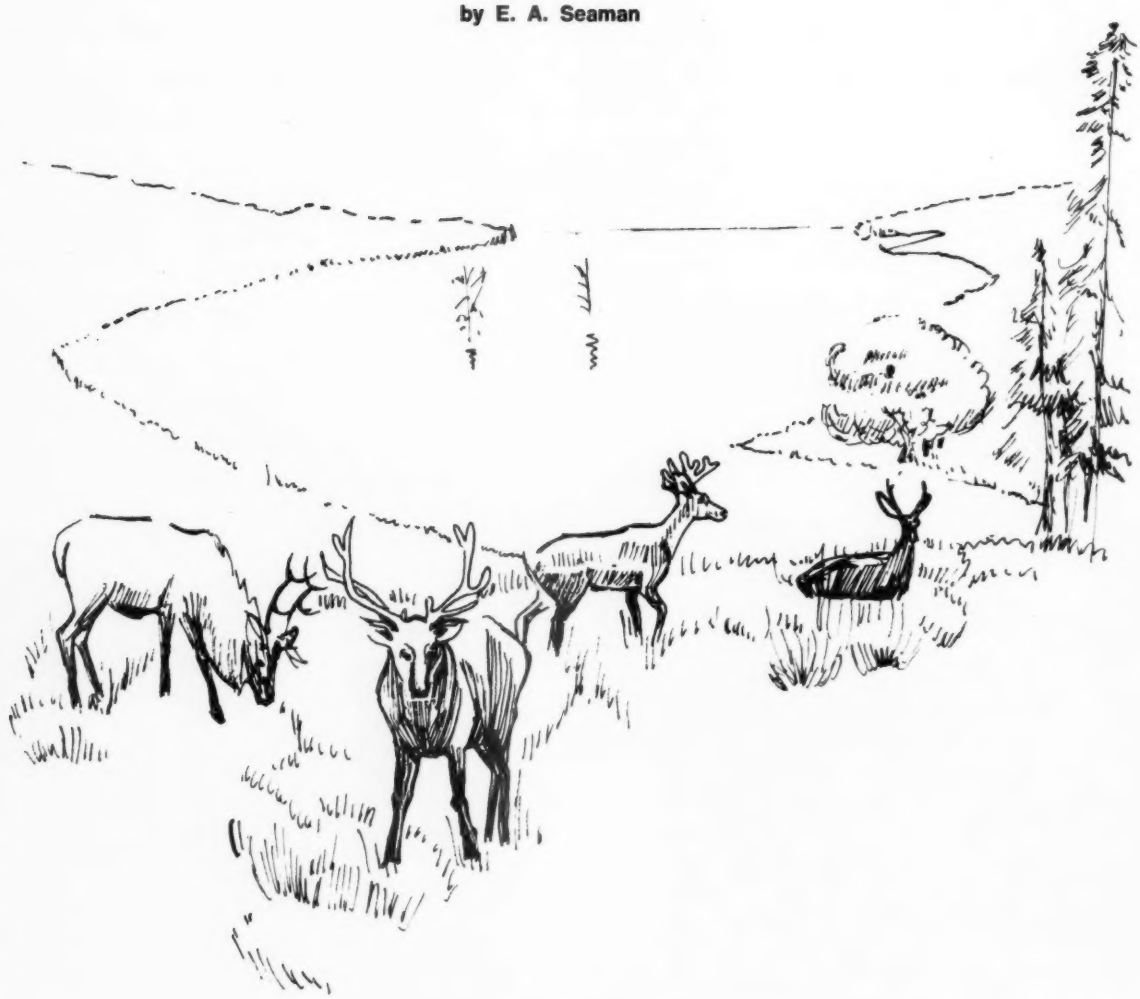
Among the crops grown in the Columbia Basin are sugar beets.

A land once barren now produces many crops.

Doing It Right

Environmental Considerations at Scoggins Dam

by E. A. Seaman



In a time when most Americans are concerned about the environment, it is refreshing to see environmental concerns assuming foremost importance on construction projects. The Bureau of Reclamation's Scoggins Dam in Oregon is one of many such projects. But because it is a dam with so many uses, it merits special discussion. It truly is a project where things have been done right and it is good to see another example where someone is "doing it right."

Scoggins Dam and Reservoir, also known as Henry Hagg Lake, were dedicated last spring by Gilbert G. Stamm, Commissioner of Reclamation. At the ceremony he said, "I want specifically to point out what a terrific job the project engineer, Francis O'Connor, did in implementing sound environmental controls on this project." And sound they were.

Since it has been found that noise may be fatiguing to workers on the project and residents in nearby areas and that health and safety may be impaired by excessive amounts of noise, O'Connor instituted noise controls during construction.

O'Connor also required that aesthetic viewing stations be built. One viewing station is used for watching elk graze on the banks of the reservoir—and there will be increasingly more to watch. The Oregon Game Division of the State Wildlife Commission, under the leadership of biologist Gene Herb, is now establishing a seeded habitat for elk. About 50 acres are presently planted with legumes and grass.

During the past winter a herd of 46 elk stayed for a while in the new habitat development which was partially responsible for the Bureau's purchasing lands, referred to as "buffer zone lands." These lands separate the recreation public from wild animals such as the elk and 50 mule deer which also enjoy the environs of the reservoir.

Nestled in a valley of Douglas fir, Scoggins Reservoir provides a home for another creature—the osprey. These large fish-eating hawks look like white-breasted eagles. They prefer to nest in isolated tree tops or on poles 20 to 50 feet high, and they favor a lake, river, or bay as their front yard. So, to accommodate their environmental preferences, several dead trees were left standing in the upper end of the reservoir basin. An additional benefit derived from allowing the trees to remain standing is that fish have found shelter and food among the underwater growth.

Birds other than the osprey also have been attracted to the reservoir. One bald eagle visited the lake, and even a whistling

Nestled in a valley of Douglas fir, Scoggins Reservoir provides a home for another creature—the osprey.

E. A. Seaman is the Assistant to the Commissioner for Ecology in the Bureau of Reclamation, Washington, D.C.

Trees were left standing in the reservoir for osprey nesting.

swan came by! Canvasbacks, scoup, ringnecks, widgeons, pintails, and a few other duck species frequented the lake last winter. It looks like a good lake for birds indeed! Last spring a brood of mallard were seen—another "plus" from the buffer zone habitat development. Fishing is another element that has improved as a result of Reclamation's activities at Scoggins Dam. Rainbow trout fishing has proven to be excellent; 10,000 6-inch trout were stocked—many of which are now caught as 15-inchers. The native cutthroat trout also are beginning to increase in the lake.

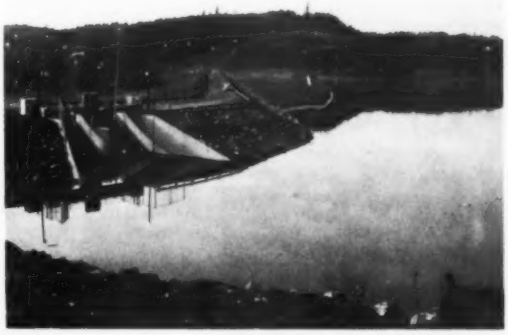
In addition, the steelhead trout and coho salmon that migrate up Scoggins Creek to the Dam will be able to spawn in a newly constructed fish facility and their young will return to the stream later in the season.

The Bureau of Reclamation has established a velocity barrier cap on the inlet structure of the dam outlet works. This will decrease the number of fish that might pass through the outlet and hence will reduce the mortality rate. The Oregon Fish Commission, under the local leadership of Lincoln Pearson, is cooperating with the Bureau on these projects.

Concern for the environment as it relates to recreation also has been demonstrated. Since recreational demands on the reservoir are great, four boat ramps and related facilities are being constructed. Mainly for safety reasons, it is not always possible to permit use of an impoundment while it is filling. But at Hagg Lake the surroundings were safe enough that people were permitted to use the lake for recreation as it filled. And they were a pleased public.

One bald eagle visited the lake, and even a whistling swan came by!

Dad and son enjoy the fine fishing at Henry Hagg Lake.



Scoggins Dam and Reservoir.

A major complaint of environmentalists and ecologists in the past has been the appearance of borrow areas after construction. Nowadays this complaint is being eliminated by putting top soil on graded areas and reseeding the areas after the grading is completed. At Scoggins Dam, however, the project engineer actually required reseeding while the rock and earth were being removed! In fact, as one approaches the dam from the downstream side, the "green appearance" makes the dam almost unnoticeable.

Phase II of the Tualatin project is now in the planning stage. Bureau planners, working closely with local and State biologists and recreation specialists, expect to develop an even better reservoir management scheme for the larger and separate reservoir which also will be environmentally sound. But so far, the Scoggins Dam and

The Scoggins Dam and Reservoir truly are another example of a project where we are "doing it right."

Reservoir truly are another example of a project where we are "doing it right."

Sailboating is another sport enjoyed at Henry Hagg Lake.

Water Quality Investigations

by Dr. Wayne Deason

In only a few years, water from the Colorado River will be delivered far into Arizona.

Of concern to Arizonans is the quality of the water. Rivers that are used heavily for recreation often have water quality problems, such as high bacterial counts, associated with such uses. Since the Colorado River is used for boating, swimming, water skiing, and fishing, Arizonans have been concerned that the water quality might be less than it should be.

Of concern to Arizonans is the quality of the water.

To eliminate apprehensions concerning poor quality water, two independent studies are being undertaken—one with the Department of Hydrology and Water Resources, University of Arizona, and the other a bacterial study being conducted by the author.

Water for the Central Arizona project will be diverted from the Colorado River at Lake Havasu. The pumping plant will be located on the south shoreline of the Bill Williams arm of Lake Havasu, close to Parker Dam. Parker Dam backs up one of Arizona's and California's most heavily-used lakes.

The Central Arizona project will provide a means by which water-deficient, agricultural, municipal, and industrial areas of Maricopa, Pinal, and Pima Counties, Ariz., can obtain a supply of water. The metropolitan areas of Phoenix and Tucson also will realize a substantial benefit from this new supply of water not only for the above-mentioned purposes but for outdoor recreation, fish and wildlife enhancement, and sediment detention benefits as well.

The Bureau of Reclamation and the Arizona Water Commission jointly contracted with the University of Arizona to undertake a comprehensive inventory of water conditions at Lake Havasu and in particular the Bill Williams arm. The objective of the investigation is to characterize the chemical, physical, and biological properties of the inflow from the Bill Williams River and their influence upon the waters of the Colorado River. The purpose of this characterization is to identify potential problems that may exist or can be foreseen that would be detrimental to the Central Arizona project.

Based upon an established sampling grid, water samples are collected monthly so that quality analyses can be made. These analyses include productivity evaluations using carbon 14 analysis procedures, benthic invertebrate analyses, and phytoplankton and zooplankton analyses.

Dr. Wayne Deason is the supervisory environmental specialist in the Bureau of Reclamation's Lower Colorado Region, Boulder City, Nev. He has a Ph.D. in microbiology.

The bacteriology study is designed to look at selected heterotrophic bacteria* through the use of selective and chemically defined media (bacterial food). In particular, total bacteria, total coliforms and fecal coliforms (colon bacteria) are being investigated. These kinds of bacteria are prevalent because Lake Havasu and the Colorado River provide the Southwest with a heavily-used recreation base both during summer and winter months. The data collected will be provided

The data collected will be provided to the managers and operators of the Central Arizona project.

Dr. Wayne Deason takes dissolved oxygen measurements on the south shore of the Bill Williams Arm of Lake Havasu.

* Heterotrophic bacteria require complex organic compounds of nitrogen and carbon for metabolic synthesis.

Dr. Deason evaluates Lake Havasu water with the aid of a volumetric pipette.

to the managers and operators of the Lake Havasu feature of the Central Arizona project and will serve as a baseline of information relative to bacterial densities.

Bacteria are being collected primarily during the summer when the lake stratification is greatest. This allows researchers to obtain data on vertical distributions of the bacteria. Secondary investigations are being performed during the winter and spring when the turnover in the water of the lake occurs. Results between these seasons are then compared. Samples are also being collected from the Bill Williams River before it enters the lake, to determine the bacterial quality of the river. Before entering the lake, the river traverses agricultural farmland; the runoff may have an effect upon water quality of the river.

Upon entering the lake, the Bill Williams River becomes part of the Havasu National Wildlife Refuge, an area heavily used by migrating waterfowl. Chemical and bacterial sampling of the refuge will reveal any undesirable components of the delta area.

These studies illustrate one way in which the Bureau of

These studies illustrate one way in which the Bureau of Reclamation is attempting to better the environment for its water users.

Reclamation is attempting to better the environment for its water users. By studying water quality, the Bureau can identify problems before they become dangerous. The data gathered from these studies of Lake Havasu water will be used by Central Arizona project managers to help them deliver a better product to the water-thirsty State of Arizona.

Water
Quiz

1. What is latent heat?
2. Describe how ice chills a drink.
3. Water has been called a "universal solvent." Why?
4. Capillarity refers to:
   a. water's ability to cling to the surface of a solid—enabling it to creep uphill under some conditions
   b. the capacity of water to oxygenate itself—as when flowing rapidly in a mountain stream
   c. water's ability to conduct electricity
   d. the mechanism by which water transports those substances dissolved in it
5. Water is a good conductor of electricity. True or false? Why or why not?

Answers on page 27.

Water for
and

by R
Robin

As 1975 draws to a close, it seems fitting to reflect upon the impact water has had on the United States' production of food, fiber, and energy.

Two basic human needs, food and energy, have been highlighted in the past year by numerous worldwide events. Both have reached critical shortages and have required forceful, if not dramatic, solutions. Growing shortages of food as well as fiber require rapid application of the best and most effective technology available for increasing production. No less important is the need to develop viable and specific alternatives for supplying water at the time and place required to assure energy self-sufficiency for the Nation.

Roy Rush is the Assistant Programs Officer in the Planning Division, Bureau of Reclamation, Washington, D.C.

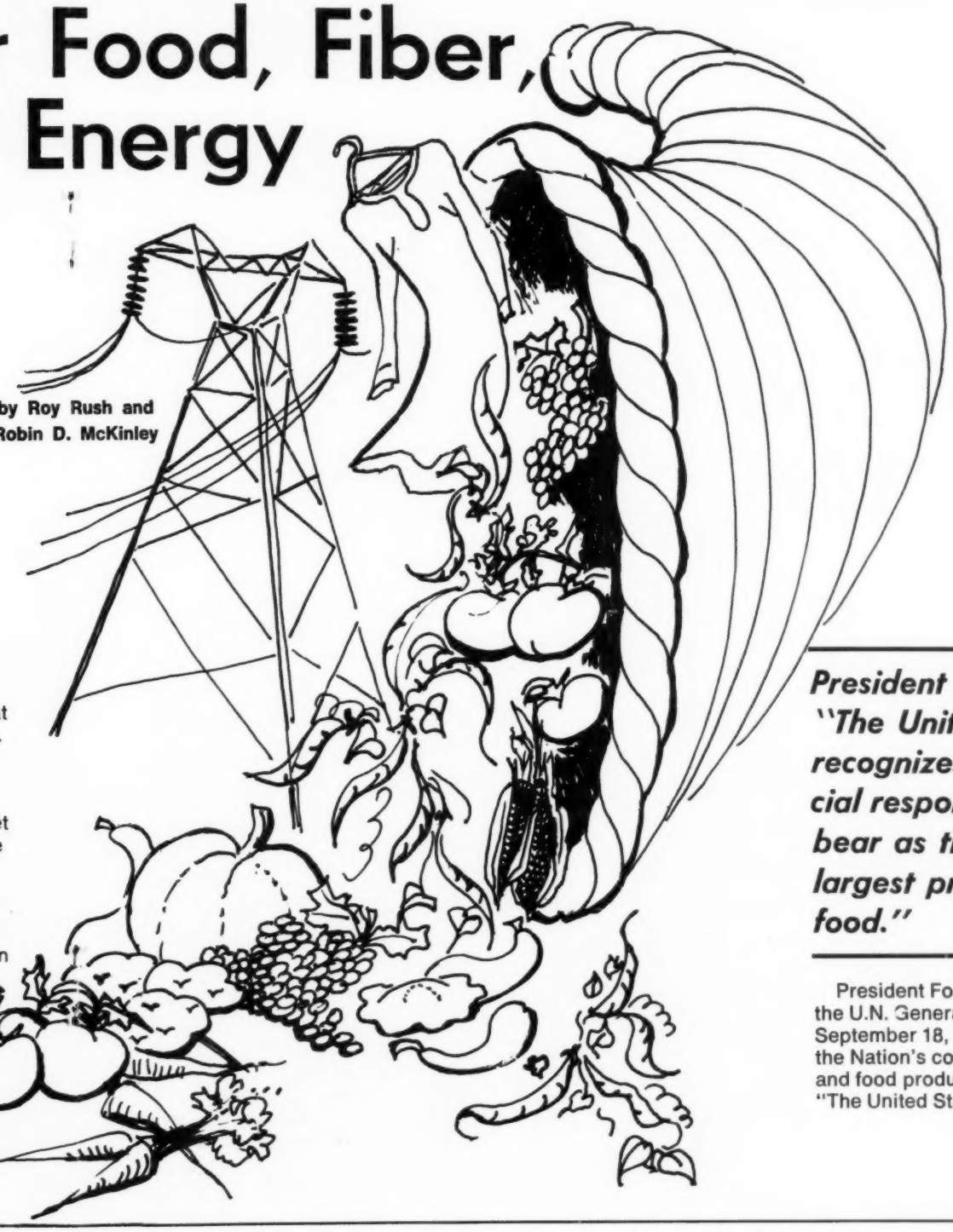
Robin D. McKinley is an economist in the Economics and Program Analysis Branch, Division of Water and Land, Bureau of Reclamation, Washington, D.C.

In early 1975, food prices for the American consumer were 42 percent greater than just 3 years earlier.

In early 1975, food prices for the American consumer were 42 percent greater than just 3 years earlier. This situation was reflected in dramatic increases in farm beef prices, tripled wheat prices, and doubled corn prices. Clearly something new had happened to the food market, a market which has fed Americans well for decades—a market which allowed Americans to use only a small portion of their income for food. In the last few months, prices have fluctuated, but the basic forces supporting growing demand for food remain and will not disappear.

Food, Fiber, Energy

by Roy Rush and
Robin D. McKinley



President Ford said, "The United States recognizes the special responsibility we bear as the world's largest producer of food."

President Ford, speaking to the U.N. General Assembly on September 18, 1974, emphasized the Nation's concern for energy and food production. He stated, "The United States recognizes

Water is used to produce the man-made fibers used in this carpeting.

the special responsibility we bear as the world's largest producer of food . . . energy is required to produce food, and food to produce energy. And both to provide a decent life for everyone."

The increased export demand, coupled with greater domestic demand, has focused attention on the need to develop fully our available natural resources. United States agricultural exports in calendar year 1973 reached $18 billion, up from $9.4 billion in 1972. Demand for United States agricultural exports has been high, almost $22 billion in 1974, and is expected to remain high, producing a major favorable impact upon our international balance of payments.

Increased export sales have resulted from higher world income and a population growth of about 200,000 persons per day. Although, hopefully, this world growth rate will decline, the resulting demand will require a high level of production of agricultural products in the United States. The existing and potential world market offers an arena in which the United States has a demonstrated competitive advantage in selling its produce.

The doubling of gasoline prices and the tremendous increase in electricity and oil prices have focused attention on the continuing need for energy production.

Population growth has obviously been a significant factor in increasing world food demand. However, an even more striking element has been the recent increase in cereal (grain) consumption per capita in developed countries where the population has not been growing rapidly. This increase is largely due to an increase in livestock production. This is the case because it takes much grain to produce livestock. Affluence as well as population, increase the world food demand as demonstrated in the following table.

PER CAPITA CEREAL CONSUMPTION
(in pounds)

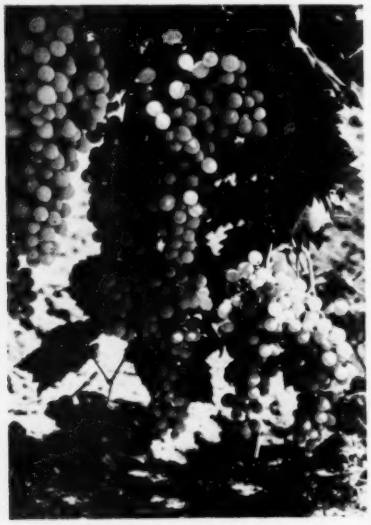
	1964-66 Average	1972-74 Average	Percent Increase
United States	1600	1850	16
U.S.S.R.	1105	1435	30
European Community	900	1000	11
Japan	530	620	17
China	420	430	2
Developing Countries (ex-China)	370	395	7

Source: Economic Research Service, U.S. Department of Agriculture

Note that in the 9-year period the increases in per capita consumption for the United States and the Soviet Union (250 and 330 pounds per capita) were more than half the total consumption per capita in developing countries. These increases reflect the preference for meat over cereal products in the more affluent countries.

The doubling of gasoline prices and the tremendous increase in electricity and oil prices have focused attention on the continuing need for energy production. However, if there is a shift in the use of our natural resources, water still must be shared among energy, food, and fiber production.

President Ford and Secretary of State Henry Kissinger have directed a new national emphasis on energy and food production over the past year through speeches to the United Nations, the World Energy Conference, the Food Conference, and elsewhere. The Department of the Interior has had principal responsibility for the Nation's natural resources (whether for irrigation, energy, or recreation) for more than a century. Accomplishment of national goals will be affected by the Department of the Interior's determination of what regional values take priority over others, and how much of the resources will be conserved for future generations.



The need for a program emphasis on energy production has been recognized and has been acted upon within the Department. The time to recognize an equally important program emphasis on agricultural production is now at hand.

Alternatives to an increased emphasis on a food and fiber production program do not paint a rosy picture. Left to a free market, the food and fiber demand could cause prices to rise drastically and could create famine in the less developed countries of the world. For as long as there has been trade among people and nations, the high-income people have commanded the food they wanted, when they wanted it. Higher prices would mean less purchasing power and inferior diets and living standards for the lower-income consumer in our country, and similarly, the people of developing nations would be priced out of the international market.

Left to a free market, the food and fiber demand could cause prices to rise drastically and could create famine in the less developed countries of the world.

Historically, the Department of the Interior has worked to achieve its long- and short-term goals by utilizing its most powerful resources—technology and people. Trained human resources are an indispensable ingredient in an aggressive agricultural and energy research and development program.

As an example of Federal Reclamation program production capabilities, the following 1974 Bureau of Reclamation data are presented: (1) 55 million tons of food and fiber were produced on 9.4 million acres of irrigated land, (2) gross crop value was $4.7 billion, (3) nearly 52 billion kilowatt-hours of electrical energy were marketed from its hydroelectric plants, (4) municipal and industrial water needs for about 16 million people were met, (5) recreation use at recreation areas totaled approximately 64 million visitor days, and (6) significant flood control benefits of about $176 million were realized.

Because this is a world of vastly different countries, the economic situation of each country has a different impact on the other countries. For example, the tragedy of recent years in the African Sahelian zone was a catastrophe almost exclusively for those people. In contrast, in 1972 and 1973 proportionally smaller changes in Russia's wheat production set off worldwide reverberations. With the great dependence of the world on the cereal supplies of the United States, a substantial production change in the United States could have equally sharp effects on other countries.

The relationship between population growth and food supply growth must be considered by the short and long terms. Regions of the world are experiencing shortages of food now. At the world level, food production has stayed ahead of population growth. However, during the 1952-72 period, if allowance is made for the effect of rising incomes as well as population growth on the demand for food, the increase in food production was less than the increase in domestic demand for food in 54 of 85 developing countries.

The latest Food and Agricultural Organization of the United Nations (FAO) index numbers of world food and agricultural production indicate an increase of 1 percent in 1974 over those of 1973; a 2 percent increase in the developing countries was indicated.

Protecting future food demand and production is difficult but trends can be distinguished. It appears that in the year 2000 more than twice as much food will be required as was required in 1970.

Energy consumption and energy fuel production together rose steadily for about a century. However, in the last decade the growth in demand accelerated while domestic fuel production essentially has leveled off. Practically all of the increase in energy fuel consumption after 1970 was supplied by oil imports. By 1973, gross annual energy use in the United States reached 75 quadrillion (1 quadrillion = 10^{15} = 1 million × 1 million × 1 thousand) British thermal units (Btu's) but production from natural sources was only 62 quadrillion Btu's. In other words we are using 10.6 percent more energy than we are producing from natural resources.

Energy demand compared to supply has reached crisis proportions and is expected to be a continuing problem. During the period 1960-74, United States gross energy consumption increased at an annual rate of 3.6 percent. In 1973 petroleum and natural gas constituted 77 percent of the gross energy consumption. It is estimated that by 1990 petroleum and natural gas will supply only 57 percent of the gross energy with nuclear sources making up most of the deficit.

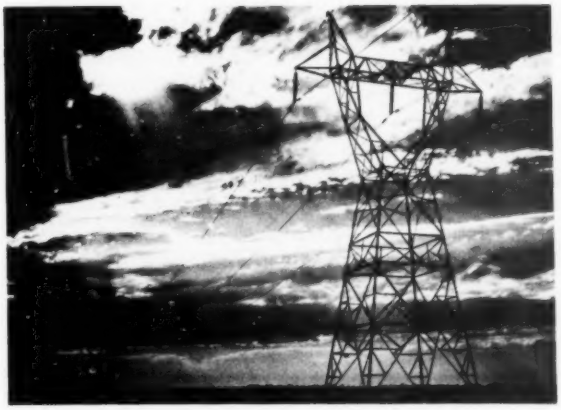
An energy source shift to include nuclear power as a significant energy source in the future is of interest to water resource planners and developers because of the high water requirement for conversion to useful electricity. Recent data indicate an increase in the average water requirement for all sources of energy from 102,000 acre-feet per quadrillion Btu's in 1973 to about 240,000 acre-feet per quadrillion Btu's in 1990. Such an increase reflects source distribution shift only, not the increased energy demand which is projected for the future.

Worldwide trends caused the United States to become the major supplier of food for international markets and its role is expected to expand.

If there must be a shift in the emphasis placed on energy production versus food production, it must be analyzed carefully to avoid shortchanging any one area. Such a shift would require analyzing the following: (1) a summary of the Nation's present capacity; (2) the schedule and capacity of projects in the planning stage and their total capacity for increased food and fiber production; (3) the possibilities of additional irrigation facilities not in the planning stage; and, (4) the possibilities for speeding up the construction and planning phases.

Worldwide trends have caused the United States to become the major supplier of food for international markets and its role is expected to expand. In addition, the dependence of the lower-income countries on food imports is expected, by 1985, to be nearly double the 1970 level. These two points add up to heavy dependence by the developing countries on developed countries such as the United States as suppliers of food.

The increasing requirements for food, fiber, and energy have placed demands on the Nation's uses of water resources. But the Department of the Interior and the Bureau of Reclamation, with appropriate planning and foresight, can help the Nation keep pace with those demands.



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"We're trying to see how we can keep the rock and sand from filling up the dam's stilling basin without spending a lot of money every year to clean it."

That's how Phil Burgi, a hydraulic engineer, explained a working model of a Montana dam that recently underwent extensive hydraulic testing in the Bureau of Reclamation's laboratory in Denver, Colo.

Burgi said, "The labs have been conducting studies on a model of Canyon Ferry Dam for more than a year in order to solve what appears to be a mysterious spillway happening."

"The labs have been conducting studies on a model of Canyon Ferry Dam for more than a year in order to solve what appears to be a mysterious spillway happening."

In 1972, nearly $100,000 was spent to clean more than 17,000 cubic yards of rock and sand from the lower spillway apron and from the stilling basin. Burgi said, "In some years, mounds of material as high as 30 feet had accumulated in various portions of the basin."

Canyon Ferry Dam is a 225-feet high, 1,000 feet long, gravity-type concrete structure located on the Missouri River near Helena, Mont. It provides for the storage and release of water for recreation, preservation of fish and wildlife, power production, flood control, irrigation, and municipal water.

Ten years after construction on the dam started in 1948, the unexpected and unwanted deposits of riverbed material began to be troublesome. In 1960 an examination that not only was expensive but caused considerable operating inconvenience was conducted to determine the latest location of accumulated material.

To learn why the deposits were accumulating, Reclamation's research labs at the E&R Center in Denver constructed a precisely-scaled hydraulic model of the dam and its associated works at a scale of 1 foot equaling 48 feet. In addition to the dam, the model included part of the reservoir, powerplant, pumping plant, irrigation and municipal water facilities, and about 450 feet of the river channel downstream from the dam. All features were perfect duplications including the topography of the river bottom.

After several months of experiments with the hydraulic model which employed almost all possible combinations of releasing water over the spillway of the dam, through the river outlet tubes, and through the powerplant and pumping plant, the mystery began to unravel.

Tests showed that when the river outlet tubes were operated at high releases an undertow effect existed along the bottom. This undertow effect moved riverbed material in an upstream direction, depositing it in large amounts in the stilling basin.

This instability resulted in movement of riverbed rock and sand into the spillway stilling basin. With this discovery, hydraulic engineers recognized that they would have to stabilize the existing riverbed downstream from the stilling basin or reduce the water release from the outlet tubes.

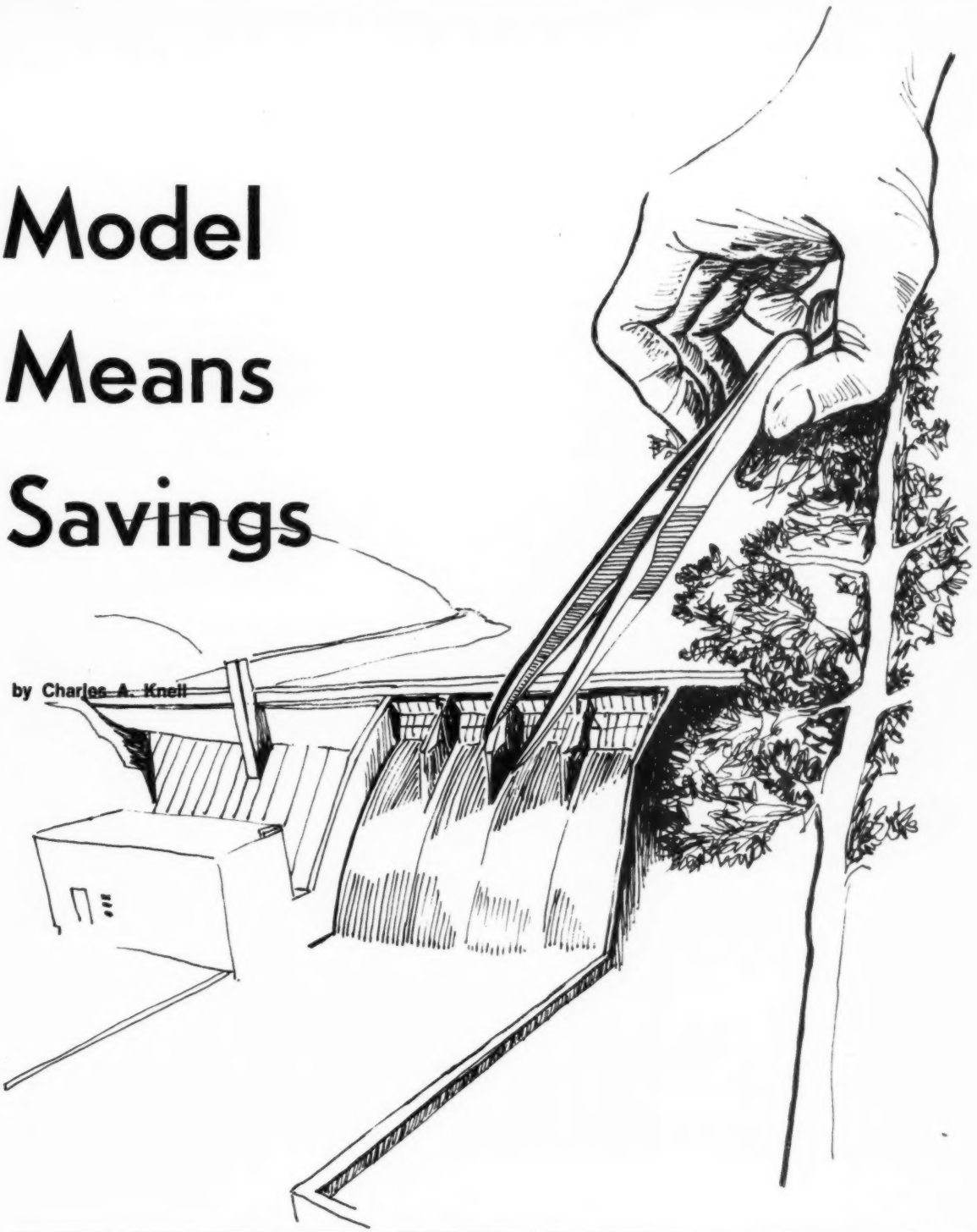
A precisely-scaled hydraulic model of the dam and its associated works was built.

But, with the discovery of this new problem, the question of why the river bottom was experiencing such instability became important. Where was the material coming from? Why was it showing up so long after construction?

Charles A. Knell is the Field Public Affairs Officer, Bureau of Reclamation, E&R Center, Denver.

Model Means Savings

by Charles A. Knell



Where was the material coming from? Why was it showing up so long after construction?

Further extensive testing and on-site investigations showed that the answers to these questions were found as a result of construction activities at the Helena Valley pumping plant nearly 10 years after start of construction on the dam.

The pumping plant, located about 100 feet downstream from the stilling basin, contains two hydraulic pumps which lift water up steep and sheer canyon walls bordering the Missouri River. From there it is transported via a tunnel to a reservoir from which water is supplied for irrigation to the Helena Valley irrigation project and to the city of Helena, Mont., for municipal use.

To carry out construction of the pumping plant, a cofferdam was erected in the Missouri River to detour riverflow during construction. Construction of the cofferdam was started in May 1957.

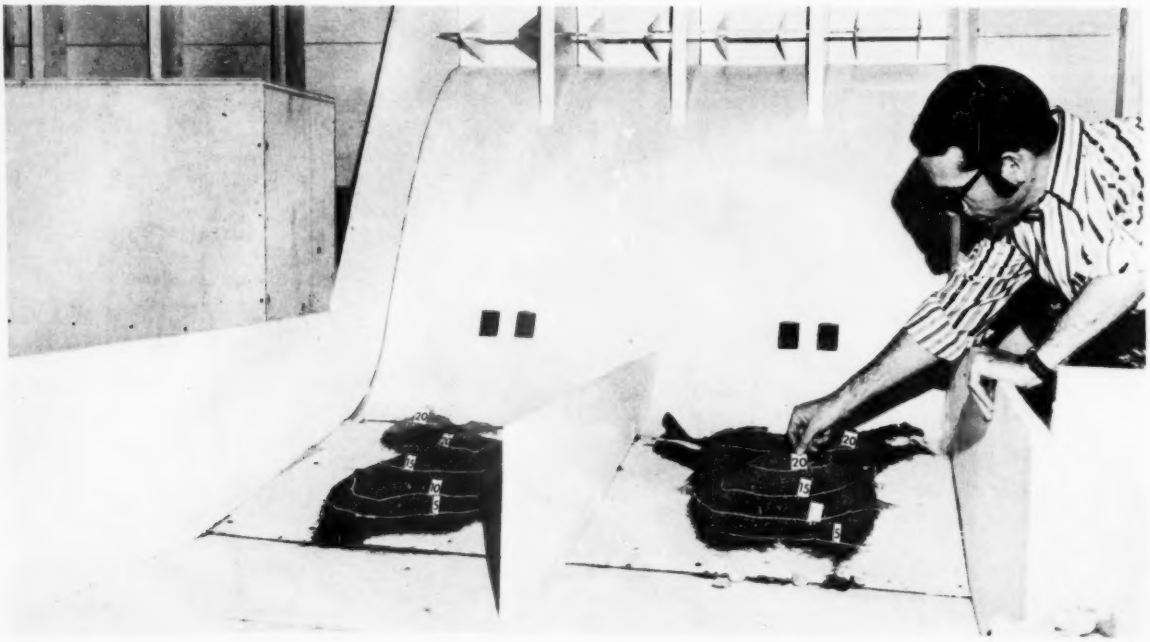
In June 1957, large releases of water from the Canyon Ferry Reservoir to the river were required in order to transmit large reservoir inflows. At that time the cofferdam was about three-fourths complete and the large releases washed away a major part of the uncompleted cofferdam.

But, following reconstruction, the cofferdam again suffered severe damage after heavy releases in 1958. It was concluded that in some manner, material used in constructing the cofferdam had washed out and had been deposited on the river bottom producing a degree of instability.

Model tests indicated that movement of the riverbed material up into the basin resulted from operation of the river outlet works at discharges greater than 3,000 cubic-feet-per-second (ft^3/s). It was also discovered that riverbed material was not carried into the stilling basin with the release of water from the spillway, powerplant, or Helena Valley pumping plant, but was limited to operation of the river outlet tubes.

Several solutions to the problem were developed, including limiting operation of the river outlets to 3,000 ft^3/s. The outlets were originally designed to discharge 9,500 ft^3/s.

One of the alternative solutions was to clean the river



Hydraulic engineer Philip H. Burgi identifies the contour elevations of the deposited riverbed material.

bottom of loose riverbed material. The cleaning would go as deep as bedrock for a distance of 100 feet downstream from the stilling basin and it would be done only where the river bottom slope was great enough to require it (a ratio of 4 to 1). This would be expensive but it would prevent the movement of riverbed material into the basin.

Still another alternative was developed—a method for operating the spillway to counteract the effect of high river outlet releases, thus controlling the movement of riverbed material. Model tests were conducted where the two center spillway gates and the two outside river outlets were operated simultaneously. Tests also were conducted releasing 4,750 ft^3/s through the two outside river outlet conduits and 4,800 to 10,000 ft^3/s through the two center spillway gates.

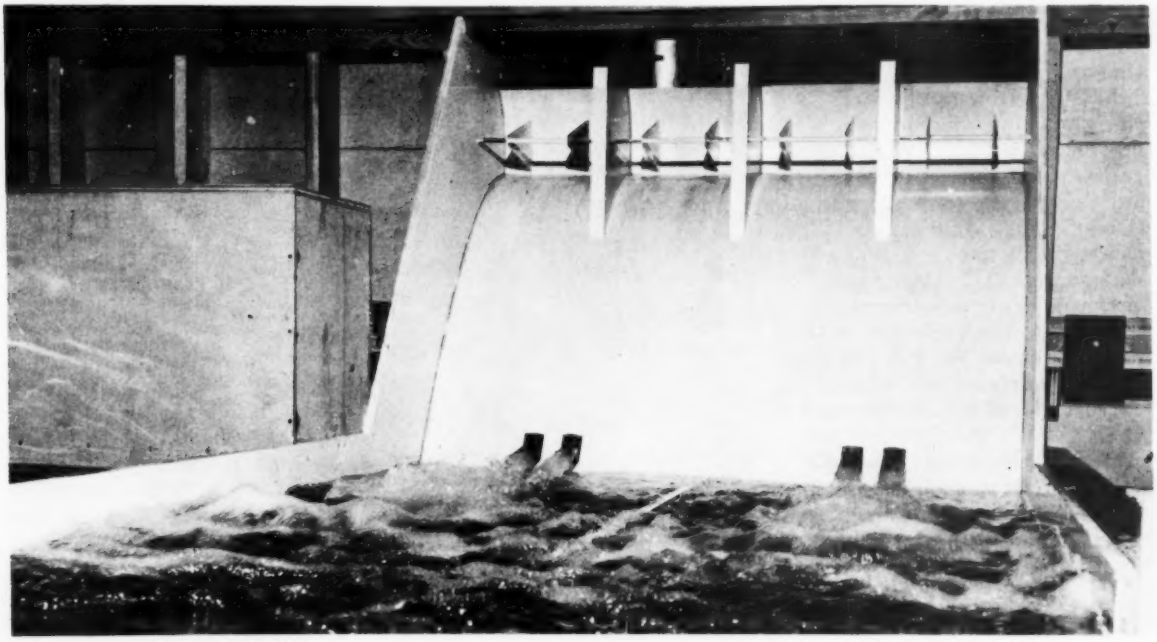
This simultaneous operation was successful in controlling the riverbed movement. However, close observation was required to make sure that the spillway and river outlet jets did not intercept during operation.

This simultaneous operation was successful in controlling the riverbed movement.

The most acceptable and practical solution revealed through the model tests was to change operational procedures for the river outlet tubes. Tests had conclusively proved that riverbed material was not being carried into the stilling basin from water released from the spillway, powerplant, or the Helena Valley pumping plant but only from the river outlet tubes at high discharge rates.

As a result of the laboratory model testing, Canyon Ferry Dam will now be operated with a maximum discharge of 3,000 ft^3/s from the river outlet tubes. If higher releases are necessary, the two center spillway gates and two outside river outlet tubes will be operated simultaneously up to a release of 14,800 ft^3/s. To release larger flows, the outlet tubes will be closed and all four spillway gates will control the higher releases.

These newly devised operational procedures will bring about dollar savings by avoiding new construction, future expensive stilling basin cleaning, and operational problems for downstream users of water.



The high discharge rate from the river outlet tubes shown in this model caused an undertow effect.

News Notes

First L.C. Regional Director Dies

Ernest A. Moritz, known as "Mr. Reclamation," died August 21, 1975, nine days before his 93rd birthday. He was the first Regional Director of the Lower Colorado Region.

Moritz's first position with Reclamation was a summer job on the Garden City project in Kansas in 1905. In the fall of that year he became an instructor in applied mathematics at the University of Wisconsin.

In 1970 Moritz returned to Reclamation to start an assignment as an assistant engineer on the Yakima project in Washington State. He transferred to Reclamation's Washington, D.C., Office in October 1912. While in Washington, D.C., Moritz was in charge of engineering plans, specification and contract analysis and review. He was also the editor of *Reclamation Record,* a forerunner of the *Reclamation Era.*

Moritz transferred to the new Office of Design and Construction in Denver in 1915 and organized the engineering section there.

He resigned in April 1921 to enter private business with his brother and returned to Reclamation in 1934 as an engineer at Parker Dam in California. In 1941, he became director of power at Hoover Dam.

When the Bureau of Reclamation was regionalized in 1943, Commissioner Harry Bashore named Moritz Regional Director of Region 3.

In April 1952, Moritz retired and was awarded the Distinguished Service Award of the Department of the Interior for his outstanding Government service.

Record Recreation Use at Bureau Reservoirs

Bureau of Reclamation reservoirs are fast becoming some of the Nation's most popular recreation attractions.

Preliminary figures showed that water-related activities at Bureau projects attracted a record 63.8 million visitor days of public recreation use during 1974, an increase of 7.4 million over 1973.

Lake Mead National Recreation area, including Hoover Dam, continued to lead all Reclamation areas in public usage, drawing 6.5 million visitor days. Hoover Dam, which has been open to the public for 40 years, expects its 17th-million visitor this fall.

The second most popular reservoir was Shasta Lake in northern California, followed by Lake Havasu on the Colorado River on the Arizona-California border, Jackson Lake in Wyoming, Lake Berryessa and Folsom Lake, both in California, Lake Thunderbird in Oklahoma, and Lake Meredith near Amarillo, Tex.

Westwide Study Report Released

Future planning for water resources development in the Western United States will move away from project-oriented solutions toward programs emphasizing total water management, water conservation, and the environment.

This was the major conclusion reached in the Westwide Study—a report on "Critical Water Problems Facing the Eleven Western States"—released by the Department of the Interior.

The report, which is the product of the Western U.S. Water Plan Study authorized by Congress in 1968 as part of the Colorado River Basin Project Act, was coordinated by a full-time management team in Denver, Colo.

The report says that "While projects are and will remain important to water resources conservation and development, current trends in planning are placing greater emphasis on much broader objectives attuned to meeting a wide variety of human needs.

"Those objectives include environmental considerations, economic efficiency, total water management, augmentation of water supplies, energy resource development, conservation and reuse of water, water quality improvement, and development of Indian resources.

"Water and related planning must be a continuing activity in the West even after the bulk of the desirable water supply and regulation features has been constructed," the report says.

The study recommends 72 specific Federal investigations between 1976 and 1985 to find solutions to mounting pressures on the West's limited water supplies for development of energy resources, increased agricultural production, protection of the environment, and water to meet demands of the area's growing population, including Indian needs.

The report includes detailed discussions of both regional and specific State water problems together with suggested steps to resolve them.

Commissioner of Reclamation Gilbert G. Stamm said the report represents the most comprehensive assessment to date of water resource problems in the West, and will be a valuable tool in defining the scope and character of future Federal and State water resources investigations in the West through the year 1985.

Answers to Water Quiz

1. Latent heat is the additional heat needed to change the form of a substance without changing the temperature of the substance once that temperature has reached the point of change. For instance, when ice melts, it absorbs a certain amount of heat. But up to a point, in spite of the absorption of heat, the temperature of the substance remains the same. A latent heat transfer also occurs when ice is forming. Water releases heat as it turns into ice. But in spite of the fact that heat is being released, the temperature of the substance does not change. This heat exchange is measured in small units (calories or Btu's). For example, the calories are required in the transformation of ice to water.
2. As ice melts, it absorbs heat from the liquid which surrounds it. This is the primary mechanism by which ice chills a drink.
3. Water is a good solvent because of its dipolarity (a water molecule has both a positive and a negative charge). This allows water to weaken the bonds of ionic substances (ionic substances are those made of positively and negatively charged atoms). As the bonds are weakened, the atoms making up the substance are separated, and the substance is dissolved.
4. a, Capillarity is possible because of water's surface tension property.
5. Pure, distilled water is not a good conductor. However, water which contains impurities, as is generally the case, is a good conductor because such water has the free, charged particles which enable a substance to be a good conductor.

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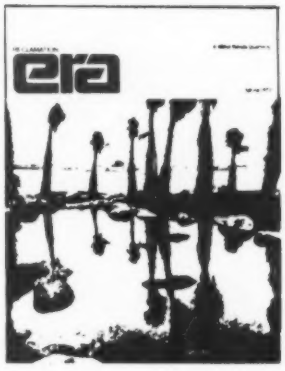

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